Waste Evaluation Performed for Wehran Engineering

Waste Generator: L.E. Carpenter

Waste Description: Polyvinyl Chloride (PVC) Sludge

Volume: Not Available

Sample Date: 7/20/79
Report Date: 9/06/79

I. Waste Characterization

Representative samples of L.E. Carpenter - PVC Sludge were evaluated at Recra for their:
a.) physical and chemical analyses
b.) reactivity properties, and
c.) their solubility properties

The following data was compiled:

1.) Physical and Chemical Analyses

Physical Appearance: The sludge is highly viscous and it does not flow or pour. The sludge, which is multicolored (green, blue, red, yellow, and tan), does adhere to glass, plastic and metal.

Odor: The PVC sludge does have a detectable organic (solvent-like) odor which is not unpleasant.

Total Solids (103^{o}C): 89.0%
Ash Weight (600^{o}C) : 23.5%

Flash Point: 98^{o}F (Fisher-Tag Closed Cup - no agitation)

Layering: A trace amount of free liquid was found to be present within the voids of the sludge. The liquid has the following analyses:

Appearance:	clear amber, low viscosity liquid
pH:	6-7
s-TOC:	17,750 mg/l
s-TIC:	250 mg/l

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Infrared Analyses: The IR scan showed very broad and strong intensity at 3400 cm^{-1}, medium intensity at 2060 cm^{-1} and medium to strong intensity between 1650 cm^{-1} and 400 cm^{-1}. The scan was interpreted to be primarily water. Any organic absorption was masked by the water.

2.) Reactivity

A series of qualitative reactivity tests were performed with the sludge to determine possible adverse reactions which may occur with heat and pH changes.

The following observations were noted:

a.) with 10% NaOH

Reacting the PVC sludge with an excess solution of 10% NaOH does not yield any signs of exothermicity or gas evolution. The reactions were performed at 22° and 100°C.

b.) with 50% NaOH

Reacting the PVC sludge with an excess amount of 50% NaOH does not yield any signs of exothermicity or gas evolution. The caustic solution does partially react with the sludge yielding a white, turbid aqueous solution and fine, white, settleable solids.

c.) with Dilute Acid

The PVC sludge is only partially dissolved in acid media, with the majority of the reacted sludge settling out as fine particulate.

d.) with 80% Sulfuric Acid

Reacting the PVC sludge with a strong sulfuric acid solution does show signs of exothermicity when the reaction was performed under ambient conditions. There were no signs of gas evolution, particularily HCl. At 100°C, this reaction is more noticeable with the sludge breaking up yielding a dark green solution and fine particulate which settles to the surface and on the bottom.

3.) Solubility

A series of qualitative solubility tests were performed on the PVC sludge to determine its solubility properties with aqueous and organic media under variable pH temperature conditions.

The following observations were noted:

a.) with water

Mixing the PVC sludge with an excess amount of water at pH 1, 7 and 11 does partially dissolve some of the sludge constituents yielding a gray solid mass and a white, turbid solution.

3.) Solubility (cont.)

b.) with straight-chain Aliphatics

Aliphatics, such as acetone and hexane, do partially dissolve the PVC sludge under ambient conditions (22-25^{o}C). White, solid particulate settles out of solution.

c.) with Aromatic Solvents

Aromatics, such as benzene and toluene, do partially dissolve some of the sludge constituents. The majority of the waste does settle out as a solid.

d.) with Chlorinated Hydrocarbons

Chlorinated solvents, such as methylene chloride, chloroform, and carbon tetrachloride, did break up the sludge into fine particles. At elevated temperatures, the solvents did partially dissolve the sludge constituents with the majority of the waste settling out as fine, whitish-gray particulant.

Note: With each solubility test, the sludge was vigorously agitated with each respective solvent and the final observations were noted immediately after the reaction.

II. Chemical Analyses

Table I summarizes the analyses of the PVC sludge.

III. Physical and Chemical Properties of Polyvinyl Chloride

The following information pertains to the production and general properties of polyvinyl chloride.

I. General Properties of PVC

Polyvinyl chloride is a fine white powder which is odorless, tasteless, chemically inert, and non-flammable. PVC is insoluble in all cold solvents but soluble in hot chlorinated solvents.

Decomposition of PVC is recognized by the odor of HCl and a gray, black, or dark brown color. PVC is light and heat sensitive when <u>not</u> stabilized.

Compounding with other chemicals, PVC can be stabilized, colored, and made flexible with stabilizers, color pigments, and plasticizers.

a.) Stabilizers are added to PVC to improve its physical and chemical properties before application. Some of the stabilizers used frequently are:
1.) basic lead carbonate
2.) tribasic lead sulfate

TABLE I

THE CHEMICAL ANALYSES OF
THE POLYVINYL CHLORIDE SLUDGE
FROM L.E. CARPENTER

PARAMETER	UNITS OF MEASURE	SAMPLE IDENTIFICATION L.E. Carpenter/ PVC Sludge
Dry Weight	%	89.0
Phenol	µg/g (dry)	360
Total Antimony	µg/g (dry)	500
Total Barium	µg/g (dry)	170
Total Cadmium	µg/g (dry)	274
Total Chromium	µg/g (dry)	2,100
Total Copper	µg/g (dry)	56
Total Cobalt	µg/g (dry)	< 0.8
Total Lead	µg/g (dry)	14,000
Total Magnesium	µg/g (dry)	38,000
Total Tin	µg/g (dry)	40
Total Zinc	µg/g (dry)	3,800
Total Chlorinated Organics	µg/g (dry) as Chlorine; Lindane Standard	18.3
Total Volatile Chlorinated Organics	µg/g (dry) as Chlorine; Carbon Tetrachloride Standard	< 1.0
bis(2-ethylhexyl) phthalate	µg/g (dry)	< 0.2
butyl benzyl phthalate	µg/g (dry)	< 0.2
di-n-butyl phthalate	µg/g (dry)	24.7
di-n-octyl phthalate	µg/g (dry)	< 0.2
diethyl phthalate	µg/g (dry)	1.8
dimethyl phthalate	µg/g (dry)	< 0.2

COMMENTS: All analyses were completed according to U.S. Environmental Protection Agency methodologies. Values reported as "less than" indicate the working detection limit for the particular parameter/sample. Vinyl chloride analyses could not be completed. This particular material elutes very early under the chromatographic conditions used. In the case of vinyl chloride analyses of sludges, the vinyl chloride monomer co-elutes with the methanol solvent used in preparation of the sludge. Without sub-ambient temperature control of the GC conditions, vinyl chloride cannot be separated from the distilled-in-glass methanol solvent. Total Chlorinated Organic (TCO) results do not include volatile constituents. TCO results are for screening purposes only and are not designed for qualification or quantification of any specific chlorinated organic compound. TCO and TVCO results are calculated based upon the response factors for Lindane and Carbon Tetrachloride, respectively, but do not imply either the presence or absence of either compound itself. Total Volatile Organics (TVCO) results do not include the possible presence of vinyl chloride due to solvent co-elution.

III. Physical and Chemical Properties of Polyvinyl Chloride (Cont.)

3.) basic silicate of white lead
4.) dibasic lead phosphite, dibasic lead phthalate and other calcium, barium, bismuth and tin compounds.
5.) also epoxides are used to a limited extent

b.) Plasticizers used in PVC production

Plasticizers used in PVC applications vary according to the properties desired for the application used. Commonly used plasticizers are: aromatic ethers, ketones, esters, chloroesters, and other similar compounds. Also used are petroleum oils and nitrile rubbers.

c.) Lubricants

Lubricants are often used instead of plasticizers in PVC applications. Common lubricants are: lead stearate, paraffin - type waxes, mineral oil, calcium stearate and other natural and synthetic waxes.

d.) Fillers used PVC production

Fillers in PVC are used to lower costs and to enhance certain properties that are desired. Common fillers are: calcium carbonate, carbon black, and antimony oxide.

IV. Toxicity Rating for PVC

The following data is stated for the toxicity of polyvinyl chloride

1.) According to Sax, Dangerous Properties of Industrial Materials, PVC has the following Toxic Hazard Rating:

a.) PVC is implicated as a possible teratogen
b.) PVC can cause allergic dermatitis
c.) PVC is an experimental carcinogen and causes neoplasms. The International Agency for Research on Cancer upon review states insufficient data to classify.

V. Reactivity Hazard

PVC will react violently with F_2. PVC is decomposed at 300°F evolving toxic fumes of HCl. Tolerance 1 ppm in air.

VI. Leaching Potential Tests

1.) Test Procedure

One liter of distilled water was mechanically shaken with 250 grams of PVC sludge for 48 hours. The sludge was allowed to settle for 72 hours. The supernatant liquid

VI. Leaching Potential Test - 1. (Cont.)

was poured off through a 0.45 micron filter membrane. The analyses of the leachates are summarized on Table II.

2.) Test Conditions

a.) The PVC sludge, untreated, was mixed directly with one liter of distilled water, pH 6.1. The leachate, labelled A-1, was slightly turbid, not layered but it did have a slight organic odor.

b.) The second leachate test was performed with 250g of PVC sludge with 12.5g of calcium carbonate mixed in the sludge. The calcium carbonate was added as a buffer. The leaching test was performed in the same manner. The leachate, B-1, was clear after settling.

3.) Observations

Both leachates, A-1 and B-1, were evaluated for their physical and chemical characteristics.

Leachate A-1, PVC sludge untreated, was acidified with concentrated nitric acid to a pH 1. With pH-adjustment, an organic layer separates out to the surface. The organic layer, which is $<1\%$ of the total volume was analyzed by Infrared Analysis. The IR scan does suggest the presence of a ketone or an ester (acetate). The IR scan showed strong carbonyl stretching at $1725 cm^{-1}$, and strong aliphatic carbon-hydrogen absorptions in the $3000-2800 cm^{-1}$ and $1450-1350 cm^{-1}$ regions. No chlorinated or aromatic absorptions were detected.

No layering was detected when sample B-1 was acidified.

Note: The organic analyses of leachates A-1 and B-1, Table II, were performed without any pH adjustment to the samples.

TABLE II

L.E. CARPENTER/PVC SLUDGE
LEACHING POTENTIAL TESTS

PARAMETER	UNITS OF MEASURE	SAMPLE IDENTIFICATION	
		A-1	B-1
pH	Standard Units	8.40	8.36
Conductivity	µmhos/cm	762	520
Chloride	mg/1	48.5	26.4
Phenol	mg/1	56.0	48.0
Total Organic Carbon	mg/1	310	215
Total Chlorinated Organics	µg/1 as Chlorine; Lindane Standard	< 1.0	< 1.0
Soluble Antimony	mg/1	3.0	1.6
Soluble Cadmium	mg/1	0.13	< 0.01
Soluble t-Chromium	mg/1	0.008	0.012
Soluble Copper	mg/1	0.086	0.034
Soluble Lead	mg/1	< 0.02	< 0.02
Soluble Magnesium	mg/1	64.6	36.2
Soluble Zinc	mg/1	0.339	0.266

A-1: Leachate of the PVC sludge
B-1: Leachate of the PVC sludge, containing calcium carbonate

COMMENTS: All analyses were completed according to U.S. Environmental Protection Agency methodologies. Values reported as "less than" indicate the working detection limits for the particular sample/parameter. Total Chlorinated Organic (TCO) results do not include volatile constituents. TCO results are for screening purposes only and are not designed for qualification or quantification of any specific chlorinated organic compounds. TCO results are calculated based upon the response factor for Lindane, but do not imply either the presence or absence of Lindane itself.